SOV/126-6-6-22/25

AUTHORS: Polyakov, S. N. and Starodubov, K. F.

TITLE: Influence of Manganese and Molybdenum on the Solubility of Carbon in α-iron and the Kinetics of the Process of Separation of Carbon from the α-iron in the Presence of Manganese and Molybdenum (Vliyaniye margantsa i molibdena na rastvorimost' ugleroda v al'fa-zheleze i kinetika protsessa vydeleniya ugleroda iz al'fa-zheleza v prisutstvii margantsa i molibdena)

PERIODICAL: Fizika metallov i metallovedeniye, 1958, Vol 6, Nr 6, pp 1110-1121 (USSR)

ABSTRACT: Investigation of the solubility of carbon and nitrogen in commercial iron is of much theoretical and practical interest, particularly from the point of view of elucidating the nature of such phenomena as temper brittleness, ageing, blue brittleness. The view has been expressed by various authors (Refs.1, 2), that the cause of temper brittleness is the effect of the alloying elements on the shape of the curve of solubility of the carbon in α-iron. However, as far as the authors are aware, no direct experimental data are available on this point, mainly since investigation of the solubility of carbon in α-iron is difficult due to the fact that its content in the solid solution is low (Ref.3). Finkel'shteyn and Rozin (Ref.4), Wert (Ref.5) and Dijkstra (Ref.6) applied the method

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Influence of Manganese and Molybdenum on the Solubility of Carbon in α-iron and the Kinetics of the Process of Separation of Carbon from the α-iron in the Presence of Manganese and Molybdenum

of internal friction, based on the occurrence of pronounced peaks of internal friction as a function of temperature for studying the behaviour of carbon and nitrogen in solid solutions. For an oscillation frequency of 1 c.p.s. a peak due to nitrogen occurs at 20°C and a peak due to carbon occurs at 30°C. Snoek (Ref.7) has shown that this effect ceases after complete elimination of carbon and nitrogen and therefore these internal-friction peaks are due to the penetration of these elements into the atom lattice and it is to these elements that this effect is ascribed. It follows from the theory of low-temperature anomalies of the internal friction that the magnitude of the internal friction peak is proportional to the content of atoms of carbon or nitrogen in the solid solution if their concentration is low, irrespective of the shape and dimensions of the excess phases (carbides and nitrides). This fact opens up extensive possibilities for investigating the processes of decomposition of solid solutions of carbon

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and nitrogen in α-iron and the influence of various alloying elements on the solubility of carbon and nitrogen in α-iron. The aim of the work described in this paper was to study the influence of Mn and Mo on the character of the decomposition of the solid solution of carbon in α-iron and the plotting of the high-temperature part of the curve of solubility of carbon in iron in the presence of these elements. In choosing the materials for investigation the authors took into consideration the fact that manganese increases the susceptibility of the steel to temper brittleness (Ref.8) whilst molybdenum, in quantities of 0.4 - 0.5%, reduces this susceptibility. The experimental melts were prepared in such a way that two ingots were produced from a single melt, one being of a commercially-pure iron, the other being of iron alloyed with the appropriate element. The alloys were produced in a vacuum-induction furnace; the ingots were subjected to diffusion annealing for 24 hours at 1200°C and were forged into rods of 8 mm dia. The starting material for the experiments was wire of 0.7 mm dia, produced by drawing of ground blanks. The chemical composition

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formation of a special molybdenum carbide which completely liquidates the temperature solubility of carbon in the α-iron in the range 720 - 550°C; d) influence of Mo on the kinetics of separation of the carbon from α-iron. The kinetics of this process can be studied from the graphs, Fig.4; the presence of 0.4% Mo does not show a strong decelerating influence on the decomposition of the solid solution. In the given case, there is no incubation period and the entire process terminates in 30 or 15 min at 650 and 550°C, respectively. The authors explain the possible mechanism of the influence of Mn and Mo on the Type II temper brittleness as follows: the presence of these elements, Mn and Mo, changes the temperature characteristics of the solubility of carbon in the body of the grain and apparently also at the boundaries of the α-iron grains which brings about an increase (in presence of Mn) or a decrease (in presence of 0.4% Mo) in the relative quantity of the carbides separated during slow cooling. In

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some cases, the presence of special Mo carbides almost liquidates the solubility. Compared with pure iron, Mn slows down the process of separation, whilst Mo does not. The kinetics of the process may play a predominant role in the embrittlement and this seems to be confirmed by the data of Bhat and Libsh (Ref.27). On the basis of the results obtained by the method of internal friction, the authors plotted the curves of the limited solubility in the temperature range 720 to 550°C. Their conclusions can be summarised thus:
1) Mn, in a quantity of 0.75% and Mo, in a quantity of 0.4%, reduces at all temperatures the solubility of carbon in α-iron. However, the temperature characteristic of the solubility curve is such that in the presence of 0.75% Mn, the relative quantity of the separation phase in the temperature range 650 - 550°C is greater than for pure iron and in the case of 0.4% Mo, it is the same as in pure iron;
2) the kinetics of the process of separation of carbon from the solid α-solution in the case of alloying with Mn and Mo differ greatly. Whilst alloying with Mn brings about an

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Influence of Manganese and Molybdenum on the Solubility of Carbon in α-iron and the Kinetics of the Process of Separation of Carbon from the α-iron in the Presence of Manganese and Molybdenum

incubation period, there is no incubation period in the case of alloying with Mo;
3) the activation energy of the diffusion of carbon in the case of alloying with Mn and Mo was determined; this was found to equal 19 000 ± 1000 cal/mol in both cases, i.e. it was found that 0.75% Mn and 0.4% Mo have practically no influence on the speed of displacement of carbon in α-iron;
4) the activation energy of the process of decomposition was evaluated analytically and it was found that the initial stage of the decomposition is determined by the diffusion of the carbon;
5) an explanation is offered (see above) of the influence of Mn and Mo on the development of Type II temper brittleness.

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which is based on the differing kinetics of decomposition of the solid solution. Acknowledgments are made to B. N. Finkel'shteyn and Yu. V. Piguzov for their valuable advice and interest in the work described in this paper. There are 6 figures, 1 table and 28 references; 18 of the references are Soviet, 9 English and 1 is German.

ASSOCIATION: Institut chernoy metallurgii AN,USSR(Institute of Ferrous Metallurgy, Academy of Sciences Ukrainian SSR)

SUBMITTED: June 28, 1957.

Card 9/9

STARODUBOV, K. F. and SAZONOVA, A. A.

(Dnepropetrovsk Metalllurgical Inst.)

"The Influence of Annealing Temperature after Hardening, and Isothermic Hardening During the Subsiding of Oscillations in Silicon Spring Steel."

report presented at Inter-vuz Conference on Relaxation Phenomena in Pure Metals and Alloys. 2-4 Apr 58 at Moscow Inst. of Steel.

Vest. Vys Shkoly, 9, 72-73, '58

S/137/62/000/001/212/237
A154/A101

AUTHORS: Starodubov, K. F., Babich, V. K.

TITLE: Investigation of the tempering processes of hardened and cold-worked steel

PERIODICAL: Referativnyy zhurnal. Metallurgiya, no. 1, 1962, 97, abstract 1I694 ("Nauchn. tr. Dnepropetrovsk. metallurg. in-t", 1958, no. 36, 43 - 58)

TEXT: The method of X-ray analysis was used to study the causes of reduction in ductility and slight increase in strength when tempering at 300 - 500°C the hardened and cold-worked "70" steel and deformed commercial Fe (0.09% C). The steel "70" was worked by drawing after patenting, and the commercial Fe - after annealing at 800°C. Tempering was carried out at 100 - 675°C in a vacuum. X-ray structural analysis revealed the width of the line (211), size of the domains D and 2nd-order distortion of the crystal lattice $\Delta a/a$. It was established that when tempering hardened "70" steel at 375 - 475°C, δ slightly decreased with an increase of the tempering temperature, and the rate of reduction of σ_b decreased. This was accompanied by an increase of H_c and breaking-up of the α-phase domains.

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Investigation of the...

When tempering the worked wire within a given temperature range, increase of H_c, reduction of the increase of δ and a drop in σ_b were also observed; refinement of the α-phase domains also took place. The tempering temperature at which these phenomena occur is lower and the intensity of the effect the greater, the greater is the degree of deformation. When tempering deformed commercial Fe analogous phenomena were also observed, but the effect was considerably less than in the case of steel "70". The tempering temperature ranges in which the described phenomena occur coincide for both steel "70" and the commercial Fe. This proves that the anomalous change in properties upon tempering is not connected with recrystallization in the working, since its temperature depends considerably on the C content. The reduction of δ and the slight increase of σ_b when tempering cold-worked steel in a temperature range of 300 - 550°C may thus be explained by refinement of the α-phase domains caused by plastic shifts in the microregions. 2nd-order distortions up to tempering temperatures of 350 - 375°C are greater in hardened steel than in worked steel; at higher tempering temperatures the 2nd-order distortions are about the same in hardened and greatly-deformed steel. In slightly deformed steel >425°C the elastic distortions remain greater, so that the α-phase domains are broken up at higher temperatures. Since an increase of

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the C content in hardened steel is accompanied by an increase of the 2nd-order lattice distortions, a shift of the temperature range of the anomalous change in properties towards the lower tempering temperatures should be observed. The anomalous change in properties taking place upon tempering cannot be explained by carbide transformation, since it occurs not only in hardened steel, but also in cold-worked steel. There are 9 references.

N. Kalinkina

[Abstracter's note: Complete translation]

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S/137/62/000/001/141/237
A052/A101

AUTHORS: Starodubov, K. F., Kossaya, I. I.

TITLE: The change in mechanical properties of low-carbon steel following ageing

PERIODICAL: Referativnyy zhurnal, Metallurgiya, no. 1, 1962, 35, abstract 1I240 ("Nauchn. tr. Dnepropetrovsk. metallurg. in-t, no. 36, 1958, 59-71)

TEXT: The effect of tempering conditions, temperature (50 - 650°C) and duration (0.5 - 60 hours), on mechanical properties (σ_b, σ_s, δ, ψ, α_k) and R_B of hot-rolled rod, cold-rolled sheet and boiler sheet grade 10 steel was investigated. The maximum increase of R_B (by 10 - 12 units), σ_b (by 8 - 10 kg/mm^2) and σ_s (by 7 - 8 kg/mm^2) was observed after 10 - 15 hours' ageing at 50°C. At the same time a decrease of δ by 3%, of ψ by 5% and a sharp drop of α_k took place.

T. Fedorova

[Abstracter's note: Complete translation]

Card 1/1

18(3), 18(7) SOV/163-59-1-28/50

AUTHORS: Starodubov, K. F., Babich, V. K.

TITLE: Variation of Coercive Force Due to Deformation of Patent Steel (Izmeneniye koertsitivnoy sily pri deformatsii patentirovannoy stali)

PERIODICAL: Nauchnyye doklady vysshey shkoly. Metallurgiya, 1959, Nr 1, pp 151 - 153 (USSR)

ABSTRACT: The patent process (hardening and subsequent quenching in liquid metals) leads to a certain heterogeneity of the submicroscopical structure of steel. The investigation covered the carbon steels 70 and 50 with a carbon content of 0.7 and 0.5%. The coercive force was measured on the coercimeter of the type due to I. V. Radchenko (Ref 1). The deformation was produced by drawing on finish draw benches. The patent process increases the coercive force. It was, however, shown by the investigation that the coercive force increases only for small deformations. If deformation exceeds 33% the coercive force drops again. The experiments showed that the decrease of coercive force due to a deformation of patent

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steel cannot be explained by the heating of the steel in the zone of deformation. The variation of the coercive force due to deformation is a phenomenon similar to that of the variation of the ratio of the intensities of the X-ray interference lines due to a deformation of patent steel, which has been described in the paper cited by reference 2. The experiments lead to the conclusion that the factors causing an increase of the dynamic distortions in the crystal lattice of the α-phase exert a strong influence upon the coercive force. Hardened steel may serve as an example. In such a steel the binding forces are greatly reduced due to the presence of carbon in the martensite lattice and hence a correspondingly high coercive force is observed. There are 1 figure and 2 Soviet references.

ASSOCIATION: Dnepropetrovskiy metallurgicheskiy institut (Dnepropetrovsk Institute of Metallurgy)

SUBMITTED: October 24, 1957

18(3), 18(7)

AUTHORS: Starodubov, K. F., Sazonova, A. A., Babich, V. K.

SOV/163-59-1-44/50

TITLE: Influence of Hardening and of Drawing Upon the State of the Fine Crystal Structure of Steel (Vliyaniye zakalki i otpuska na sostoyaniye tonkoy kristallicheskoy struktury stali)

PERIODICAL: Nauchnyye doklady vysshey shkoly. Metallurgiya, 1959, Nr 1, pp 230-232 (USSR)

ABSTRACT: This is an investigation of 55S2 steel. The temperature of the hardening bath was chosen in such a way so that a different initial structure was obtained for the drawing process. Thus the investigation covered ferrite-zementite structures, which at a temperature of 400-550° are composed either of austenite, or of martensite, needle-shaped troostite, or of a mixture of these components. The methods and procedures used in this investigation are briefly described. The results of the investigation of the modification of the grain sizes and of the distortions of second order in the alpha phase of the crystal lattice show that the dimensions of the domains of coherent scattering of X-rays (D) and the distortions of second order

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($\frac{\Delta a}{a}$) exhibit marked differences after different heat treatment. The structure obtained by a hardening and drawing treatment exhibits smaller grains and larger distortions of second order than the structure obtained by a direct decomposition of the austenite. The curves given in figure 2 for the structures which were subjected to drawing after hardening with isothermal transformation take an intermediate course between the two curves mentioned previously. In all cases the distortions of second order are greatly reduced at drawing temperatures of 400-500°. $\frac{\Delta a}{a}$, on the contrary, is at these temperatures much greater in hardened and drawn samples than in samples treated isothermally. If the drawing temperature or the temperature of isothermal decomposition of austenite does not exceed 500° the grain size varies only negligibly with the conditions of the heat treatment. If, however, drawing is carried out at temperatures exceeding 500°, the grain size varies with varying conditions of the heat treatment. After an isothermal treatment at 550° there appear interference spots

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SOV/163-59-1-44/50

which indicate a recrystallization. If martensite has been drawn at temperatures of up to 600° no recrystallization of the ferrite was observed. On the strength of these X-ray structural analyses of steel it can be concluded that the recrystallization of ferrite in steel 55S2 proceeds after phase solidification with a marked intensity in different temperature intervals. This depends upon the fact whether the ferrite was produced immediately from austenite by isothermal transformation at temperatures exceeding 300° or by way of a martensite structure due to drawing. There are 2 figures and 3 Soviet references.

ASSOCIATION: Dnepropetrovskiy metallurgischeskiy institut (Dnepropetrovsk Institute of Metallurgy)

SUBMITTED: October 24, 1957

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APPROVED FOR RELEASE: 08/25/2000 CIA-RDP86-00513R001652920017-8

PHASE I BOOK EXPLOITATION SOV/5305

Moscow. Institut stali

Relaksatsionnyye yavleniya v metallakh i splavakh; trudy Mezhvuzovskogo soveshchaniya (Relaxation Phenomena in Metals and Alloys; Transactions of the Inter-Institute Conference) Moscow, Metallurgizdat, 1960. 326 p.

Sponsoring Agency: Ministerstvo vysshego i srednego spetsial'nogo obrazovaniya RSFSR and Moskovskiy institut stali imeni I.V. Stalina.

Ed. (Title page): B.N. Finkel'shteyn; Ed. of Publishing House: Ye.I. Levit; Tech. Ed.: A.I. Karasev.

PURPOSE: This collection of articles is intended for personnel in scientific institutions and schools of higher education and for physical metallurgists and physicists specializing in metals. It may also be useful to students of these fields.

COVERAGE: The collection contains results of experimental and theoretical investigations carried out by schools of higher education and scientific research institutions in the field of the relaxation phenomena in metals and alloys. Several articles are devoted to the investigation—by the internal-friction method—of the decomposition of supersaturated solid solutions. Also analyzed are the defects of the crystalline lattice, plastic deformations, high-temperature behavior of alloys, and creep. Problems of the relation between internal friction and temper brittleness, the use of the method of internal friction in the investigation of powder-metallurgy products, and the mechanism of impact fatigue are discussed. The collection also contains articles on the damping characteristics of materials, elastic after-effect, and the new slow-detection method. No personalities are mentioned. References follow most articles. There are 366 references: 192 Soviet and 174 non-Soviet.

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S/148/60/000/008/007/018
A161/A029

AUTHORS: Starodubov, K.F.; Polyakov, S.N.

TITLE: The Effect of Annealing Temperature on the Hardness and Specific Destruction Work in Х12 (Kh12), Х12Ф (Kh12F) and Х12Ф1 (Kh12F1) Steel

PERIODICAL: Izvestiya vyssikh uchebnykh zavedeniy. - Chernaya metallurgiya, 1960, No. 8, pp. 115 - 119

TEXT: The three steel grades Kh12, Kh12F and Kh12F1 have the following chemical composition:

Grade	Content % C	Si	Mn	Cr	Ni	V	S	P
Kh12	2.1	0.19	0.28	11.62	0.14	-	0.012	0.026
Kh12F	1.56	0.25	0.25	11.9	-	0.35	0.011	0.025
Kh12F1	1.4	0.20	0.35	11.5	-	0.7 - 0.8	0.011	0.02

and belong to the ledeburite class. The specific destruction work was investigated on specimens without notch annealed for 4 h at 950°C prior to final heat treatment. The quenching temperature was so chosen as to obtain a minimum of residual austenite (i.e., for primary hardness). V.M. Doronin's method (Ref. 4)

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A161/A029

The Effect of Annealing Temperature on the Hardness and Specific Destruction Work in Kh12, Kh12F and Kh12F1 Steel

was used for heat treatment: quenching in oil from 1,000°C for Kh12 and Kh12F, and from 1,050°C for Kh12F1; holding for 15 min; annealing at 150 - 700°C at 25 - 50°C intervals, holding 1 h; cooling in air. Hardness was measured by the Rockwell C scale; the coercive force was measured by the ballistic method with a ± 2% accuracy. The determined dependence of hardness, specific destruction work and coercive force on tempering temperature is discussed and illustrated in a set of three graphs (Fig. 1) (a - for Kh12; b - Kh12F; c - Kh12F1). The conclusion is drawn that dispersion hardening takes place in two grades, Kh12F within the 375 - 475°C range, and Kh12F1 within the 500 - 550°C range. A drop of dynamic strength is stated in same ranges. The growth of the coercive force at dispersion hardening temperatures indicates the formation of new carbide phases that are coherent with the mother metal. There is 1 set of diagrams and 2 references: 1 Soviet and 1 English.

ASSOCIATION: Dnepropetrovskiy metallurgicheskiy institut (Dnepropetrovsk Metallurgical Institute)

SUBMITTED: October 15, 1959

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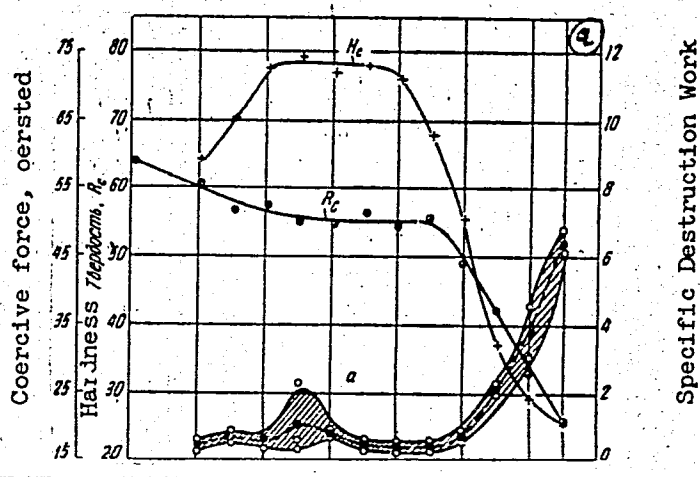
The Effect of Annealing Temperature on the Hardness and Specific Destruction Work in Kh12, Kh12F and Kh12F1 Steel

Figure 1. Dependence of the Hardness, Specific Destruction Work and Coercive Force on the Tempering Temperature.



a - Kh12 steel

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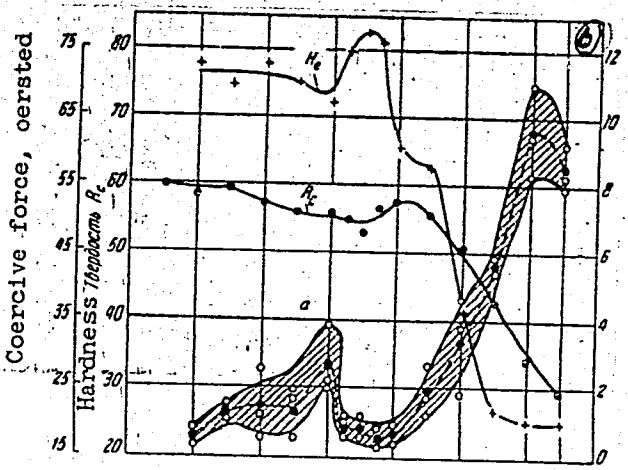
The Effect of Annealing Temperature on the Hardness and Specific Destruction Work in Kh12, Kh12F and Kh12F1 Steel



b - Kh12F steel

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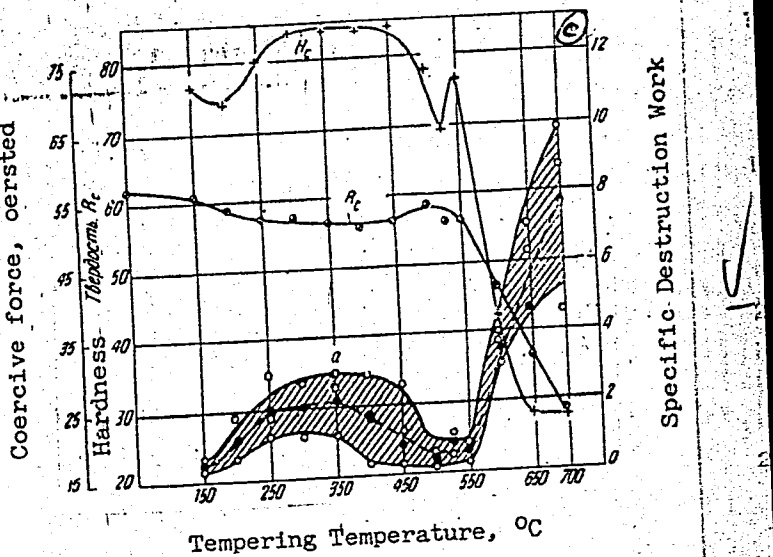
S/148/60/000/008/007/018
A161/A029

The Effect of Annealing Temperature on the Hardness and Specific Destruction Work in Kh12, Kh12F and Kh12F1 Steel



c - Kh12F1 steel

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STARODUBOV, K.F., akademik (Dnepropetrovsk)

Increasing the durability of machinery. Nauka i zhyttia 10 no.1:13 Ja '60. (MIRA 13:6)

1. AN USSR.

(Steel—Heat treatment)

STARODUBOV, K.F.; BORKOVSKIY, Yu.Z.

Changes in the microhardness of the structural components of hardened low-carbon steel depending on the temperature of tempering. Izv. vys. ucheb. zav.; chern. met. no. 11:121-124 '60. (MIRA 13:12)

1. Dnepropetrovskiy metallurgicheskiy institut.
(Steel--Metallography)
(Metals, Effect of temperature on)

S/133/60/000/011/019/023
A054/A029

AUTHORS: Starodubov, K.F., Member of the UkrSSR Academy of Sciences, Kalmykov, V.V., Engineer

TITLE: Effect of Arsenic, Phosphorus and Carbon on the Properties of Steel

PERIODICAL: Stal', 1960, No. 11, pp. 1034-1037

TEXT: In spite of large-scale research in this field, clearly defined theories on the effect of arsenic on the mechanical, technological and physical properties of steel are still lacking. As an increase in the arsenic content of steel (0.15%) is of considerable interest with a view to a more intensified application of ores from the Kerch' deposit, further investigations were carried out on this subject while taking into consideration that the optimum arsenic content of carbon steels as an embrittling element depends on the presence of other embrittling substances such as phosphorus. Three groups of steel were tested with various carbon content (in steel A:0.15%, in steel B /B/:0.45% and in steel B/V/: 0.75%) and with different arsenic content in such a way that two subdivisions in each group were made having identical carbon, as well as low and a high phosphorus content. The tests (carried out in a

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Effect of Arsenic, Phosphorus and Carbon on the Properties of Steel

40-kg induction furnace with magnesite crucible) with group A steels showed that by adding up to a maximum of 0.75% arsenic to a steel of 0.15% C and 0.013% phosphorus content, the strength and the plasticity of the metal were not affected. In group B and group V, having a C-content from 0.45 to 0.75% and a low phosphorus content, the addition of more than 0.30% arsenic decreased the relative lateral contraction in proportion to the rising C-content of the steel. In tests with more than 0.75% C-content the operative stress during rupture was also reduced. The notch impact strength of steels with a low phosphorus content at room and at low temperatures did not change when adding 0.13% arsenic and decreased only slightly when the arsenic content was raised to 0.30%. Raising the phosphorus content to 0.060% in the steel not containing arsenic, resulted in a slight increase in hardness and in the limit of strength and flow, without decreasing the notch impact strength in steels with a low-carbon content at room and at low temperatures. In steels with 0.45 and 0.75% C-content the brittleness became greater in proportion with the increase in C-content of the steel. In general the embrittling capacity of phosphorus was ten times greater than that of arsenic. Brittleness increased considerably

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Effect of Arsenic, Phosphorus and Carbon on the Properties of Steel

when adding arsenic to the steel containing 0.06% phosphorus. An amount of 0.14% arsenic in a steel having 0.15% C and 0.060% phosphorus in its composition decreased the notch impact strength from 22 to 14 kgm/cm^2 at room temperature. The brittleness of steel with 0.45 and 0.75% C and more than 0.060% phosphorus was increased further by adding arsenic. The changes in mechanical properties and notch impact strength under the effect of arsenic and phosphorus at various temperatures and compositions are plotted in graphs. There are 7 figures, 1 table and 2 Soviet references.

ASSOCIATION: Institut chernoy metallurgii AN UkrSSR
(Institute of Ferrous Metallurgy of the AN UkrSSR)

Card 3/3

STARODUBOV, K.F., akademik

Wheel hardening. Nauka i zhizhn' 27 no.2:36-37 F '60.
(MIRA 13:6)

1. AN USSR, Dnepropetrovsk.
(Car wheels)

STARODUBOV, K.F., akad.; POLYAKOV, S.N., kand.tekhn.nauk

Optimum conditions for the thermal treatment of the blades of sectional plowshares. Trakt. i sel'khozmash. 30 no.8:42-44 Ag '60. (MIRA 13:8)

(Plows)

1.1710

S/148/61/000/001/012/015
A161/A133

AUTHORS: Staroduboy, K. F., and Borkovskiy, Yu. Z.

TITLE: The effect of heat treatment on the cold brittleness of low-carbon steel

PERIODICAL: Izvestiya vysshikh uchebnykh zavedeniy. Chernaya metallurgiya, no. 1, 1961, 166 - 169

TEXT: The article presents the results of an experimental investigation proving that it is possible to preserve the toughness in low-carbon steel without tempering. The experiment material was grade "20" steel (0.19% C, 0.54% Mn, 0.27% Si; 0.018% P, 0.020% S, 0.11% Cr, 0.06% Ni). Blanks 230 mm long and 20, 36 and 55 mm in diameter were hardened at 900°C in salted cold water and tempered at different temperatures for 1 hour. Standard notch specimens were tested on a "MK-30" impact test machine at temperatures from -196 to +100°C. The upper critical brittleness points were determined by plotting curves and by the appearance of fracture. The test temperature corresponding to the bend on the cold-brittleness curve was always accompanied by an appearance of a coarse-grain component in frac-

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ture. This temperature was taken as the upper critical brittleness point (T_{cr}). Quenching in water raised the impact resistance considerably throughout the entire test temperature range, and the T_{cr} point moved 20 - 60° lower, depending on the blank diameter. Tempering after quenching brought T_{cr} farther down by some 100°C. Lowering of the T_{cr} point was stated at an increase in the tempering temperature raised to 400 - 450°C. Tempering at above 450°C raised the impact resistance but did not lower T_{cr} point. It was obvious that the T_{cr}-lowering effect of quenching increased with an increasing diameter of the quenched blanks. The T_{cr} shift was considerable (100°) even in 55 mm diameter blanks, where quenching produced only a slight improvement of mechanical properties, and such a shift doubtless increases the structural strength considerably. It may be concluded that the highest toughness reserve was in structures consisting of austenite decomposition products that formed in the range of 400 - 450°C and higher, and in structures that formed as a result of tempering at these temperatures in the case of the cooling rate in quenching being so high that austenite decomposed at lower temperatures. Thus, if low-carbon steel is quenched in a medium that causes austenite decomposition in the above indicated temperature

The effect of heat treatment on the...

range, the metal will have a maximum toughness reserve even without subsequent tempering. The quenching of blanks 30 mm in cross section and larger in water results in a maximum shift of the T_{cr} point towards low temperatures, which means that quenching must not necessarily be followed by tempering. Parts of smaller cross section need either quenching in milder media, or quenching with subsequent tempering at 400 - 450°. There are 3 figures and 1 Soviet-bloc reference. (Abstracter's note: Essentially full translation).

ASSOCIATION: Dnepropetrovskiy metallurgicheskiy institut (Dnepropetrovsk Metallurgical Institute)

SUBMITTED: May 26, 1960

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STARODUBOV, K.F.; BORKOVSKIY, Yu.A.; GUL', Yu.P.

Hardening of low-carbon steel from the rolling temperature. Izv. vys. ucheb. zav.; chern. met. no.2:109-113 '61. (MIRA 14:11)

1. Dnepropetrovskiy metallurgicheskiy institut.
(Steel--Hardening)

STARODUBOV, K.F.; BABICH, V.K.; GASIK, L.I.

Changes in mechanical properties during steel wire drawing.
Izv. vys. ucheb. zav.; chern. met. 4 no.11:155-158 '61.
(MIRA 14:12)

1. Dnepropetrovskiy metallurgicheskiy institut.
(Wire drawing)

STARODUBOV, K.F., akademik; BORKOVSKIY, Yu.Z., inzh.

Properties of low-carbon steel following hardening and tempering. Metalloved. i term. obr. met. no.5:15-18 My '61. (MIRA 14:5)

1. Institut chernoy metallurgii AN USSR. 2. Akademiya nauk USSR (for Starodubov).
(Steel alloys—Testing) (Metals, Effect of temperature on)

S/126/61/012/005/021/028
E040/E435

AUTHORS: Starodubov, K.F., Babich, V.K., Siukhin, A.F., Gasik, L.I.

TITLE: Changes in plasticity of cold-drawn wire during its annealing in the temperature range of 300 to 600°C

PERIODICAL: Fizika metallov i metallovedeniye, v.12, no.5, 1961, 765-768

TEXT: Changes in plasticity properties of St 50 steel were investigated at the Dnepropetrovskiy Metallurgical Institute by determining the relative elongation and reduction in cross-section area of vacuum-annealed specimens held for 1, 5, 10, 15 and 30 min at temperatures in the range of 300 to 600°C. After annealing, the specimens were examined by X-rays (interference lines from (110) and (220) planes). Tests were also made on cold-worked specimens at 61.6 and 87.5% deformation. Relative elongation was found to increase with increasing temperature of annealing, with a maximum of 6 to 7% corresponding to annealing temperatures within the range of 300 to 350°C. A further increase of the annealing temperature (up to 550°C) and specimen holding for

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periods of 1 to 60 min has no effect on the relative elongation whose value remains constant for a given degree of cold-working. When the specimen deformation was increased from 61.6 to 87.5% the relative elongations dropped by an approximately constant value in comparison with those given by non-deformed specimens. Identical values of the relative elongation of specimens subjected to the two degrees of deformation were obtained after annealing at 600°C. On the other hand, values of the reduction in specimen cross-section area drop sharply with increasing degree of deformation. The curve of reduction in area vs annealing temperature passes through a minimum corresponding to 450 to 550°C, depending on the duration of specimen holding at a given temperature. This is explained as being due to diffusion processes, which reduce the permissible distortion of the crystal lattice and result in a reduction of strength. A significant weakening of the background intensity in X-ray diagrams is regarded as confirming the above conclusions. It is postulated that the observed reduction in the plasticity of steel during annealing is the consequence of a breakdown of the grain and block

STARODUBOV, K.F., akademik

Investigating processes occurring during the tempering of hardened steel in the 300 - 500 temperature range. Trudy Inst.chern.met. AN URSR no.14:3-10 '61. (MIRA 14:10)

1. Akademiya nauk USSR.
(Steel--Heat treatment) (Tempering)

STARODUBOV, K.F., akademik; POLYAKOV, S.N., kand.tekhn.nauk

Absence of a connection between the phenomena of the reduction of plastic properties of steel during tempering and reversible temper brittleness. Trudy Inst.chern.met.AN URSR no.14:11-14 '61. (MIRA 14:10)

1. Akademiya nauk USSR (for Starodubov).
(Steel--Brittleness) (Plasticity)

STARODUBOV, K.F., akademik; KALMYKOV, V.V., inzh.

Effect of hardening and tempering on the properties of steel with a 75-percent content of carbon and varying contents of arsenic and phosphorus. Trudy Inst.chern.met.AN URSR no.14:40-49 '61. (MIRA 14:10)

1. Akademiya nauk USSR (for Starodubov).
(Steel alloys—Heat treatment)

STARODUBOV, K.F., akademik; BORKOVSKIY, Yu.Z., inzh.

Changes in the physical properties of low-carbon steel depending on the rate of quench hardening and the temperature of subsequent tempering. Trudy Inst.chern.met.AN URSR no.14:50-59 '61. (MIRA 14:10)

1. Akademiya nauk USSR (for Starodubov).
(Steel—Hardening) (Dilatometry)

STARODUBOV, K.F., akademik; BORKOVSKIY, Yu.Z., inzh.; LASHKOV, A.D., inzh.; TSAL'MAN, L.B., inzh.

Ways of reducing steel consumption in the manufacture of large-diameter pipes for main pipelines. Trudy Inst.chern.met.AN URSR no.14:60-65 '61. (MIRA 14:10)

1. Akademiya nauk USSR (for Starodubov).
(Sheet steel) (Pipe mills)

STARODUBOV, K.F., akademik; UZLOV, I.G., kand.tekhn.nauk

Investigating the properties of car wheel steel tempered at various temperatures. Trudy Inst.chern.met.AN URSR no.14:66-70 '61. (MIRA 14:10)

1. Akademiya nauk USSR (for Starodubov).
(Steel--Heat treatment) (Car wheels)

STARODUBOV, K.F., akademik; UZLOV, I.G., kand.tekhn.nauk

Effect of heat treatment of car wheel steel on its resistance to fatigue failure. Trudy Inst.chern.met.AN URSR no.14:71-75 '61. (MIRA 14:10)

1. Akademiya nauk USSR (for Starodubov).
(Steel--Fatigue) (Car wheels)

STARODUBOV, K.F., akademik; UZLOV, I.G., kand.tekhn.nauk; KALMYKOV, V.V., inzh.

Increasing the wear resistance of crane wheels by means of heat treatment. Trudy Inst.chern.met.AN URSR no.14:82-86 '61. (MIRA 14:10)

1. Akademiya nauk USSR (for Starodubov).
(Wheels--Hardening) (Mechanical wear)

3522
S/148/62/000/001/013/015
E073/E535

AUTHORS: Starodubov, K.F., Gul', Yu.P. and Siukhin, A.F.

TITLE: Application of induction heating for producing high strength tubes with a clean surface

PERIODICAL: Izvestiya vysshikh uchebnykh zavedeniy, Chernaya metallurgiya, no.1, 1962, 169-170

TEXT: The authors carried out experiments for the purpose of producing tubes, with high mechanical properties and a surface free from peeling-off scale, by means of induction heating (67 kc/s), applying a special cooling regime. The tubes, made of the steel 10sp (10sp) were 40 mm in diameter, 360 mm long, the wall thickness was 1.5 mm and the heating speed was 600°C/sec. The heat treatment consisted of heating to 1000°C, quenching with water, by means of a special tangential sprayer with slot openings, down to 700-600°C and then in air. This heat treatment ensured decomposition of the austenite in the range of pearlitic transformation. As a result of these experiments, tubes with a clean surface and high mechanical and technological properties were obtained. The microstructure of the weld and of the near-weld zone did not

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STARODUBOV, K.F., akademik; VOLOGDIN, V.V., inzh.; KHARCHENKO, P.F., kand.-ekonomicheskikh nauk

Effectiveness of the use of induction heating for the heat treatment of rolled ferrous metal products. Trudy Inst. chern. met. AN URSR 18:3-10 '62. (MIRA 15:9)

1. Akademiya nauk UkrSSR (for Starodubov).
(Induction hardening)

STARODUBOV, K.F., akademik; BORKOVSKIY, Yu.Z., inzh.

Effect of the method of steel smelting, welding, and other factors on the effectiveness of heat treatment of low carbon steel. Trudy Inst. chern. met. AN URSR 18:11-21 '62.
(MIRA 15:9)

1. Akademiya nauk UkrSSR (for Starodubov).
(Steel--Heat treatment)
(Metals, Effect of temperature on)

STARODUBOV, K.F., akademik; UZLOV, I.G., kand.tekhn.nauk

Investigating the effect of tempering conditions of all-rolled railroad wheels on the wheel disk metal properties. Trudy Inst. chern. met. AN URSR 18:33-44 '62. (MIRA 15:9)

1. Akademiya nauk UkrSSR (for Starodubov).
(Car wheels--Testing) (Tempering)

STARODUBOV, K.F., akademik; UZLOV, I.G., kand.tekhn.nauk; SAVENKOV, V.Ya., kand.tekhn.nauk; GOLOSHCHAPOV, A.P., kand.tekhn.nauk

Rolling and hardening machine for the manufacture of double-flanged crane wheels. Trudy Inst. chern. met. AN URSR 18: 45-50 '62. (MIRA 15:9)

1. Akademiya nauk UkrSSR (for Starodubov).
(Wheels) (Metalworking machinery) (Induction hardening)

STARODUBOV, K.F., akademik; SAVENKOV, V.Ya., kand.tekhn.nauk

Investigating the effect of addition alloys on metal properties of heat-treated railroad wheels. Trudy Inst. chern. met. AN URSR 18:51-57 '62. (MIRA 15:9)

1. Akademiya nauk UkrSSR (for Starodubov).
(Car wheels--Testing) (Metal alloys--Testing)

STARODUBOV, K.F., akademik; KALMYKOV, V.V., inzh.

Effect of arsenic on the wear resistance of rail-type carbon steel. Trudy Inst. chern. met. AN URSR 18:62-66 '62. (MIRA 15:9)

1. Akademiya nauk UkrSSR (for Starodubov).
(Steel—Testing) (Mechanical wear)

STARODUBOV, K.F., akademik; BABICH, V.K., kand.tekhn.nauk

Hardening of cold-drawn wire during low-temperature tempering.
Trudy Inst. chern. met. AN URSR 18:75-81 '62. (MIRA 15:9)

1. Akademiya nauk UkrSSR (for Starodubov).
(Wire drawing) (Tempering)

S/524/62/018/000/002/002
A006/A101

AUTHORS: Starodubov, K. F., Academician of AS UkrSSR, Babich, K. V., Candidate of Technical Sciences

TITLE: High-speed annealing of "08" (rimming) steel wire

SOURCE: Akademiya nauk Ukrayins'koyi RSR. Instytut chornoyi metalurhiyi. Trudy. v. 18, 1962. Metallovedeniye i termicheskaya obrabotka stali i chuguna, 86 - 91

TEXT: For the purpose of determining the possibility of reducing the time of softening heat-treatment for 08 steel wire, the authors studied the effect of the heating rate, the temperature and cooling rate upon the structure and mechanical properties of this wire, drawn with varying reduction (61, 85, 90, 94 and 97.5%) and having different diameters (4.0; 2.47; 2.04; 1.58 and 1 mm). The steel contains (in %): C 0.06 - 0.07; Mn 0.36; Si 0.1; P 0.018 and S 0.017. Experimental thermal treatment of the wire was conducted with the use of the electric resistance method on a unit where the heated wire specimens acted as the operational resistance. The specimen temperature was measured with a

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High-speed annealing of "08" (rimming) steel wire

chromel-alumel thermocouple welded onto the specimen. The thermocouple pulse was recorded by oscillograph МПО-2 (MPO-2). The oscillograms obtained were used to determine the temperature of heating the specimen as a function of the heating time and the current passing through the specimen. On the basis of these data, graduation curves were plotted showing the temperature dependence of the specimen upon the heating time at a given current value passing through the specimen. It was established that 08 steel wire of over 2 mm in diameter with less than 90% total deformation can be heat-treated for softening under the following conditions: heating at a rate of up to 700 degrees/sec to a temperature not below 700 - 750°C with subsequent air-cooling. Wire of less than 2 mm in diameter, obtained by drawing with over 90% total reduction can be heated at a rate up to 1,000 degrees/sec to temperatures not below 750 - 800°C with subsequent cooling at a rate which is below that of cooling in quiet air (cooling may be performed in a forehearth). Overheating in high-speed preheating to over 700 - 800°C does not impair the mechanical properties of the wire during thermal treatment. Extended chilling in air of wire, 1.6 - 4.0 mm in diameter, i.e., lowering its temperature at the moment of cooling down to 650 - 700°C, causes higher ultimate strength and reduced ductility. Chilling to temperatures below 650 - 700°C re-

S/524/62/018/000/002/002
A006/A101

High-speed annealing of "08" (rimming) steel wire

duces strength and increases ductility of the wire. Chilling in air from a temperature of 800 - 1,000°C of wire, 1 mm in diameter, with its further cooling in water, reduces its strength and raises ductility. There are 1 table and 1 figure.

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STARODUBOV, K.F.; GUL', Yu.P.

Aging of low-carbon steel hardened from the austenitic range.
Izv.vys.ucheb.zav.; chern.met. 5 no.6:103-112 '62. (MIRA 15:7)

1. Dnepropetrovskiy metallurgicheskiy institut.
(Steel—Hardening)

STARODUBOV, K.F., akademik

Tempering of steel. Nauka i zhyttia 12 no.10:18-19 O '62.
(MIRA 16:1)

1. AN UkrSSR.

(Ukraine--Steel--Heat treatment)

STARODUBOV, K.F., akademik; GUL', Yu.P., inzh.

Tendency of oxygen-blown converter steel toward aging. Stal' 22 no.2:159-160 F '62. (MIRA 15:2)

1. AN USSR (for Starodubob).
(Bessemer process)
(Steel--Hardening)

S/129/63/000/004/011/014
A004/A127

AUTHORS: Starodubov, K.F., Borkovskiy, Yu.Z., Gul', Yu.P.

TITLE: The effect of the interval between the end of deformation and hardening on the structure and properties of steel

PERIODICAL: Metallovedeniye i termicheskaya obrabotka metallov, no. 4, 1963, 48 - 50

TEXT: The authors investigated the changes of properties and fine structure of grade 20 steel - 0.19% C, 0.57% Mn, 0.27%Si, 0.016% P and 0.018% S - depending on the time which passed between the termination of hot deformation and hardening of the specimens. In conformity with up-to-date conceptions of recrystallization processes after hot deformation, it was found that the periods corresponding to the processes of rest, origination of new grains and collective recrystallization can be sufficiently clearly fixed. To obtain stable results in hardening low-carbon steels by rolling heating, the time interval between termination of hot deformation and hardening should ensure sufficient rest and recrystallization, not leading to an

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The effect of the interval between ...

extreme growth of grains. This time interval for the grade 20 steel should amount to 10 - 20 sec. There is 1 figure.

ASSOCIATION: Institut chernoy metallurgii AN USSR (Institute of Ferrous Metallurgy AS UkrSSR)

VISHNYAKOV, Dmitriy Yakovlevich, prof., doktor tekhn. nauk; ROSTOVTSEV Gennadiy Nikolayevich; NEUSTRUYEV, Aleksandr Aleksandrovich; STARODUBOV, K.F., doktor tekhn. nauk, prof., akademik, retsenzent; SOKOLOV, K.N., doktor tekhn. nauk, prof., retsenzent; DOLZHENKOV, I.Ye., kand. tekhn. nauk, dots., retsenzent; SHTEPENKO, V.Z., kand. tekhn.nauk, dots. retsenzent; KRAVTSOV, A.F., kand. tekhn. nauk, dots., retsenzent; FIL'TSER, G.A., dots., retsenzent; SILICH, A.N., st. prepodav., retsenzent; SIUKHIN, A.F., assistent, retsenzent; SAVEL'YEV, L.P., assistent, retsenzent

[Equipment, mechanization and automation of heat-treating plants] Oborudovanie, mekhanizatsiia i avtomatizatsiia v termicheskikh tsekhakh. Moskva, Metallurgiia, 1964. 467 p. (MIRA 17:10)

1. Akademiya nauk Ukr. SSR (for Starodubov).

STARODUBOV, K.F., akademik; BABICH, V.K.; SIUKHIN, A.F. [Siukhin, O.F.]

Nature of processes occurring during the quenching of hardened low-carbon steel. Dop. AN URSR no. 12:1590-1593 '64. (MIRA 18:1)

1. Dnepropetrovskiy metallurgicheskiy institut. 2. AN UkrSSR (for Starodubov).

STARODUBOV, K.F.; UZLOV, I.G.; PRIKHOD'KO, E.V.

Effect of temper conditions on residual stresses in all-welded whee s
Metalloved. i term. obr. met. no.7:14-16 Jl '64. (MIRA 17:11.

L 62825-65 EWT(m)/EWA(d)/T/EWP(t)/EWP(k)/EWP(z)/EWP(b)/EWA(c) Pf-4 JD/HM

ACCESSION NR: AP5018054 UR/0129/65/000/007/0030/0032
669.15-194:621.785

AUTHOR: Starodubov, K.F.

TITLE: Thermal hardening of low-carbon steels

SOURCE: Metallovedeniye i termicheskaya obrabotka metallov, no. 7, 1965, 30-32

TOPIC TAGS: steel hardening, deformed steel, thermal hardening, low carbon steel, steel tempering

ABSTRACT: This is a brief survey (based on 16 Soviet and Western references) of the properties of low-carbon steels following their thermal hardening. It concludes with a short description of the most economical approach to tempering following hot plastic deformation. The need for the mechanization and automation of the production of thermally hardened low-C steels is emphasized. Orig. art. has: 1 figure.

ASSOCIATION: Dnepropetrovskiy institut chernoy metallurgii (Dnepropetrovsk Institute of Ferrous Metallurgy)

SUBMITTED: 00 ENCL: 00 SUB CODE: MM

NO REF SOV: 013 OTHER: 003

Card 1/1

STARODUBOV, K.F., akademik; LARIN, T.V., doktor tekhn.nauk, prof.; UELOV, I.G., kand. tekhn.nauk; PRIKHOD'KO, E.V., inzh.

Effect of residual stresses on the deformation of seamless rolled wheels. Vest. TSNII MPS 24 no.1:35-37 '65. (MIRA 18:6)

1. Institut chernoy metallurgii AN UkrSSR i Vsesoyuznyy nauchno-issledovatel'skiy institut zheleznodorozhnogo transporta Ministerstva putey soobshcheniya.

STARODUBOV, K.F. (Dnepropetrovsk)

Transformations during steel quenching. Izv. AN SSSR. Met. no.5:59-68 S-O '65. (MIRA 18:10)

STARODUBOV, K.F.; BABICH, V.K.; SIUKHIN, A.F.

Effect of the tempering temperature on the properties of hardened low-carbon steel. Izv.vys.ucheb.zav.; chern.met. 8 no.6:137-139 '65. (MIRA 18:8)

1. Dnepropetrovskiy metallurgicheskiy institut.

L 04725-67 EWT(m)/EWP(3)/ETI/EWP(t) IJP(c) JD/HW

ACC NR: AT6026438 (N) SOURCE CODE: UR/3210/66/000/004/0249/0255

AUTHOR: Starodubov, K. F. (Academician AN UkrSSR); Rafalovich, Ts. N. (Candidate of technical sciences); Dolzhenkov, I. Ye. (Candidate of technical sciences)

31
26
B+1

ORG: none

TITLE: Use of induction heating in tube drawing 14 16 16

SOURCE: Ukraine. Ministerstvo vysshego i srednego spetsial'nogo abrazovaniya. Metallurgiya i koksokhimiya, no. 4, 1966. Obrabotka metallov davleniyem (Metalworking by pressure), 249-255

TOPIC TAGS: METAL DRAWING, motor generator set, induction motor, metal tube, hot rolling

ABSTRACT: The article describes the principles of a new method of the mandrel-free drawing of tubes, suggested by K. F. Starodubov in 1939 and perfeqted by the authors in collaboration with the personnel of a tube plant. These principles are 1) heating is combined with deformation, thus eliminating the increase in the metal's hardness and decrease in its plasti-

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city -- the disadvantages of cold drawing; 2) the heating is oxygen-free, thus preventing the formation of scale on tubes which might otherwise be incurred by merely drawing the tubes at high temperatures instead of resorting to induction heating; 3) the extent of deformation during a single rolling pass is increased to as much as 40% and the hardening of the tube occurs after passage through the drawing ring. These conclusions were verified by operating tests of an eight-ton drawing mill which was adapted for operation with an induction heating device. Tubes of 50-52 mm diameter and 2.5 mm wall thickness were heated to 750°C in an inductor through which they passed at the rate of 16-18 m/min. This, together with a drawing speed of 30 m/min, assured continuity of the hot drawing process. The inductor, located at a distance of about 6 m from the drawing ring, is represented by a spiral copper tube (65-70 turns) to which high-frequency current is supplied by a single phase machine motor generator set of the VGO-500-2500 type (500 kw, current frequency 2500 cps, 3,000 r.p.m.) connected to an ATM--700 type induction motor (2500 cps, 600 v, 700 kw). This equipment was used to draw tubes of various dimensions and steel makes (EI-459, 30KhGS, 15KhM and other steels) with satisfactory results (savings of time due to the elimination of intermediate operations such as annealing, pickling, copper plating and reduction in the volume of intra-shop manipulations of tubes). The surface of the hot-drawn tubes thus obtained, given the use of graphite lubricant, meets the requirements and standards for cold-drawn tubes. It was further established that the degree

L 04725-67

ACC NR: AT6026438

of deformation during a single drawing pass and the drawing speed of tubes in such cases may be further increased without impairing their quality. Orig. art. has: none

SUB CODE: 13, 11 / SUBM DATE: none

Card 3/3

STARODUBOV, V.A. (Karaganda)

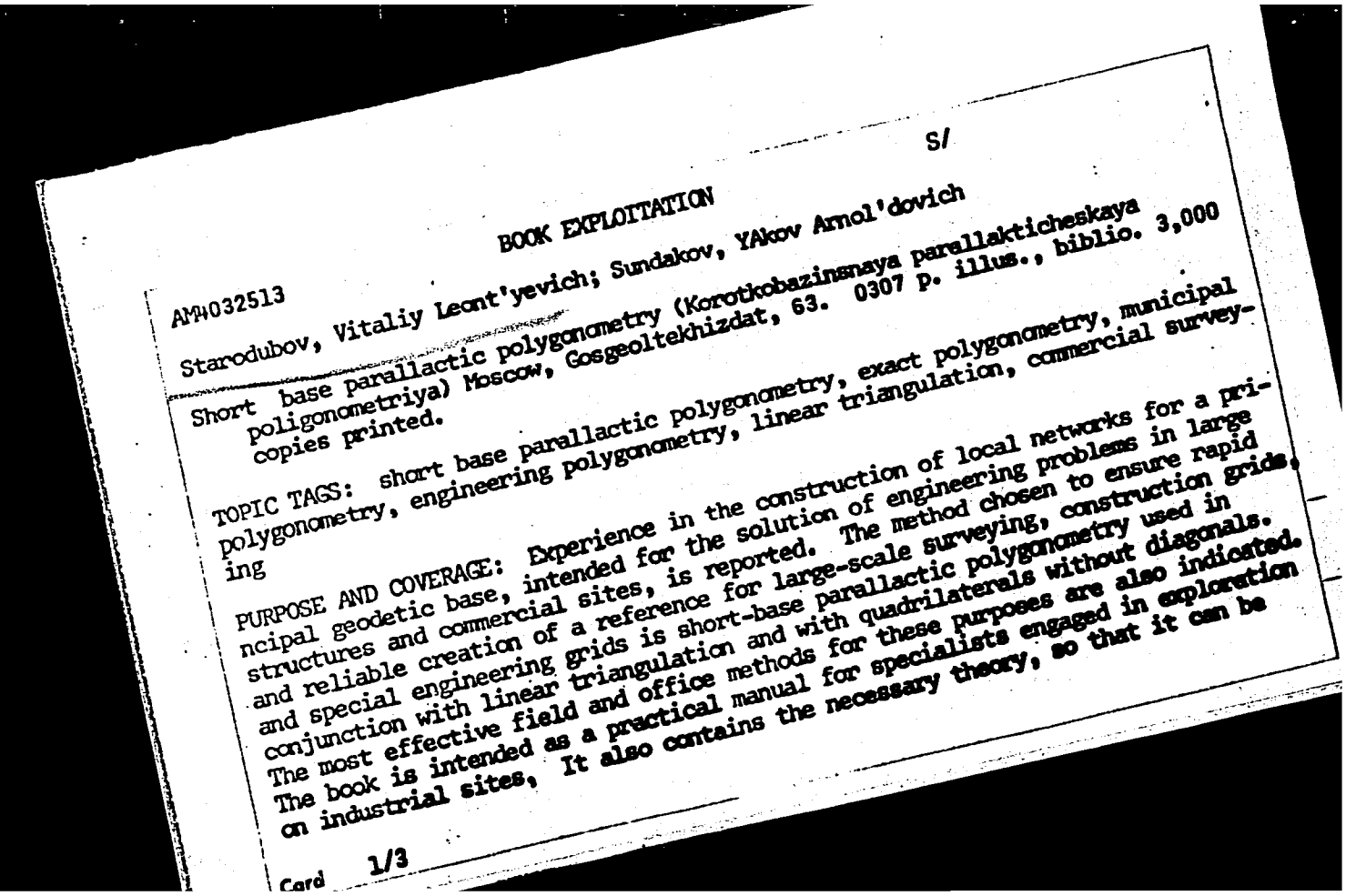
Problem concerning the increasing of the power factor and voltage stability of underground mine cable networks. Elektrichestvo no.8:81-82 Ag '62. (MIRA 15:7)

(Electricity in mining)
(Electric lines--Underground)

STARODUBOV, Vyacheslav Alaksandrovich, inzh.

Factors determining the design and choice of the networks of compounded excitation of synchronous motors in mine networks. Izv. vys. uchsb. zav.; elektromekh. 7 no.2:159-165 '64.

1. Institut "Karagandagiprouglegormash".



S/

BOOK EXPLOITATION

AM4032513

Starodubov, Vitaliy Leont'yevich; Sundakov, YAkov Arnol'dovich

Short base parallactic polygonometry (Korotkobazisnaya parallaktícheskaya poligonometriya) Moscow, Gosgeoltekhizdat, 63. 0307 p. illus., biblio. 3,000 copies printed.

TOPIC TAGS: short base parallactic polygonometry, exact polygonometry, municipal polygonometry, engineering polygonometry, linear triangulation, commercial surveying

PURPOSE AND COVERAGE: Experience in the construction of local networks for a principal geodetic base, intended for the solution of engineering problems in large structures and commercial sites, is reported. The method chosen to ensure rapid and reliable creation of a reference for large-scale surveying, construction grids, and special engineering grids is short-base parallactic polygonometry used in conjunction with linear triangulation and with quadrilaterals without diagonals. The most effective field and office methods for these purposes are also indicated. The book is intended as a practical manual for specialists engaged in exploration on industrial sites. It also contains the necessary theory, so that it can be

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AM4032513

most helpful to students of engineering geodesy in higher educational institutions. The authors are grateful to the head of the department of applied geodesy M. S. Murav'yev for initiative in publication of the work, to B. A. Litvinov for valuable remarks during the review of the manuscript and to G. P. Levchuk for useful hints.

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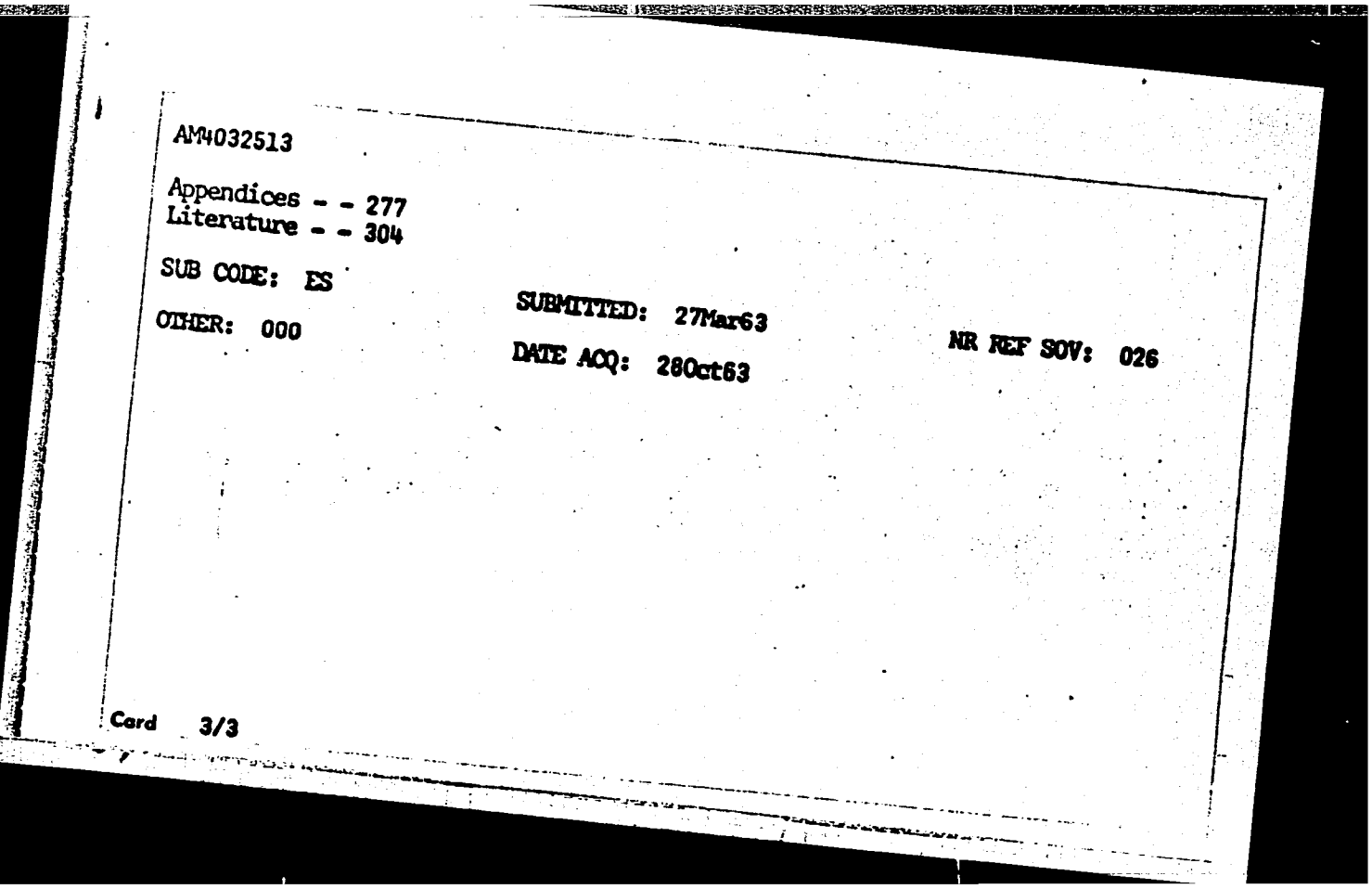

AM4032513

Appendices - - 277
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SUB CODE: ES

SUBMITTED: 27Mar63

OTHER: 000

DATE ACQ: 28Oct63

NR REF SOV: 026

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STARODUBOV, V.S., inzh.

Characteristics of drive mechanisms in machine tools with numerical program control. Izv.vys.ucheb.zav.; mashinostr. no.9:115-120 '62. (MIRA 16:2)

1. Moskovskoye vyssheye tekhnicheskoye uchilishche imeni Baumana.

(Machine tools—Numerical control)

L 29078-66 EWT(m)/T DJ

ACC NR: AP6017713 SOURCE CODE: UR/0122/66/000/003/0018/0022

AUTHOR: Starodubov, V. S. (Engineer)

35
34
B

ORG: none

TITLE: Antibacklash reduction gears for machine tools with numerical program control

SOURCE: Vestnik mashinostroyeniya, no. 3, 1966, 18-22

TOPIC TAGS: metal cutting machine tool, elastic deformation, friction loss, toughness, transmission gear

ABSTRACT: Metal-cutting machine tools with numerical program control have lately come into wider and wider use. The first models of these units were based on conventional general purpose machine tools with some modernization, and many installations are still being built on this principle. However, the full potential and all the advantages of numerical machining (primarily machining accuracy) cannot be realized by merely attaching the system to conventional machine tools. This reduces productivity and limits the range of effective application for units with numerical programming.

One of the principal methods for improving machining accuracy in systems with numerical control is the use of antibacklash mechanisms in the drive gears. Backlash in reduction gears is affected by the following basic factors: lateral play in gear engagement, elastic deformations in the gear elements,

Card 1/2 UDC: 621.9.06-529:621.833.6

play in the bearings, loose splines and loose shaft keys. Play and elastic deformations in the output elements of the gear chain have the greatest effect on backlash. All play in reduction gears may be effectively eliminated by creating preliminary tension in the closed kinematic circuit of the system. This also increases toughness of the gear. Preliminary tension increases friction losses in the system. However, these losses account for only a slight decrease (from 3 to 10%) in the efficiency of the antibacklash reduction gear. Passive coupling from the structural standpoint is introduced by making the antibacklash unit from two parallel branches. In this case, there will be oscillations in the preliminary tension if there are inaccuracies in making and assembling the antibacklash units. This results in additional dynamic loads and irregular rotation of the output shaft. The nature of the oscillations in preliminary tension depends on the nature of the errors made in manufacturing and assembling the units, while the magnitude depends on rigidity of the elastic link in the loading device and its position in the kinematic chain. The rigidity of the elastic link in the loading device should be chosen to conform with the required rigidity of the reduction gear with the lowest possible amplitude for oscillations in preliminary tension in the closed kinematic circuit of the speed reducer. Engineer N. I. Petrov took part in the research. Orig. art. has: 6 figures and 7 formulas. [JPRS]

SUB CODE: 13, 20 / SUBM DATE: none

SOV/126-7-5-25/25

AUTHORS: Gindin, I. A., Khotkevich, V. I. and Starodubov, Ya. D.

TITLE: Investigation of the Plastic Properties of Aluminium at Low Temperatures (Issledovaniye plasticheskikh svoystv alyuminiya pri nizkikh temperaturakh)

PERIODICAL: Fizika metallov i metallovedeniye, Vol 7, Nr 5, pp 794-800, 1957 (USSR)

ABSTRACT: Pure aluminium (99.994% Al) and technical aluminium containing up to 1% impurities (Si, Mn, Fe) were used for the investigation. The specimens were in the shape of plates of 2.5 x 2.5 mm cross-section and 17 mm working length, widening at the ends for ease of gripping in the testing machine. After grinding and polishing, all specimens were annealed in vacuum for one hour at 300°C. The average linear grain size in pure aluminium was 1.0 to 1.5 mm, and in technical aluminium 0.3 to 0.5 mm. Deformation was carried out in a vertical-type tensile testing machine using mechanical loading, being specially adapted for low temperature work. Tensile tests were carried out at 293, 77, 20, 4.2, 2.06 and 1.4°K. In this apparatus it was possible to carry out tensile and compression tests in liquid hydrogen as well as

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in liquid helium at 4.2°K and below. A temperature of less than 4.2°K was obtained by evacuating helium. The layout of the apparatus is shown in Fig.1. A study of the macro- and microstructure of fractured specimens has shown that the nature of plastic deformation of aluminium changes fundamentally with change in temperature from 20 - 4.2°K and below. Fig.2 shows the microstructure of an aluminium specimen (99.994%), fractured at 20°K. Fig.3 shows the microstructure of a similar specimen fractured at 4.2°K. In Fig.4 the macrostructure of aluminium specimens (99.994% Al) fractured at 20°K (a) and 4.2°K (b) is shown. In Fig.5 load-extension curves for cylindrical specimens of technically pure aluminium of 3 mm diameter (annealed at 300°C for one hour, grain size 0.3 mm) are shown for various temperatures. In Fig.6 load-extension curves for flat pure aluminium specimens of 2.5 x 2.5 mm section (annealed at 300°C for one hour, grain size 1-1.5 mm) are shown for various temperatures. Fig.7 shows load-extension curves for specimens of technically pure aluminium at 4.2°K after various preliminary treatments. In Fig.8 a micro-interference picture of the polished surface of a pure aluminium specimen, deformed at 1.4°K, is shown.

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Fig.9 is a photomicrograph of the polished surface of a pure aluminium specimen deformed at 1.4°K. The deflection of a scratch at the boundary of large blocks is visible. Fig.10 shows the deflection of interference lines at the boundary of large blocks of a pure aluminium specimen deformed at 1.4°K. In Fig.11 the dependence of the mechanical properties of aluminium on temperature in the range 1.4 to 293°K is shown. The authors arrive at the following conclusions:

1. It has been found that a sharp difference exists in the macro- and microscopic nature of plastic deformations of specimens of pure aluminium if the temperature at which they are strained is changed from 20 to 4.2°K and below. A lowering in the temperature of testing leads to an intensification of the inhomogeneity of plastic deformation; i.e. to the formation of large blocks the sizes of which exceed those of the average metal grain.
2. The plastic deformation of aluminium at 4.2°K and below is characterized by an unstable flow which is expressed the more clearly, the lower the testing temperature. Preliminary cold working of the specimens intensified the interrupted

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nature of flow.

3. At 4.2°K and below the formation of mechanical twins is observed in aluminium. It is possible that the instability of plastic flow is associated with the formation of mechanical twins.

4. The mechanical properties of aluminium in the temperature range 77-1.4°K have been determined. It has been found that the true strength of specimens of pure and technical aluminium tested to fracture at 4.2°K are close to one another. The ultimate tensile stress σ_s is practically independent of temperature. The residual elongation has a maximum in the range 20 to 4.2°K.

There are 11 figures and 9 references, of which 6 are Soviet and 3 English.

ASSOCIATION: Khar'kovskiy fiziko-tekhnicheskiy institut AN USSR (Khar'kov Physico-Technical Institute AS Ukr.SSR)

SUBMITTED: March 12, 1958

USCOMM-DC-61,699

18(0)

AUTHORS: Gindin, I. A., Lazarev, B. G., Starodubov, Ya. D., Khotkevich, V. I.

SOV/56-35-3-46/61

TITLE: The Low-Temperature Polymorphism of Metals (Nizkotemperaturnyy polimorfizm metallov)

PERIODICAL: Zhurnal eksperimental'noy i teoreticheskoy fiziki, 1958, Vol 35, Nr 3, pp 802 - 804 (USSR)

ABSTRACT: In the present paper (unlike the practice adopted by several earlier papers dealing with the same subject) the method of mechanical tests is used, in which the compression diagram of lithium, sodium, cesium, bismuth, and beryllium samples with subsequent heating are investigated. Also the variations of volume in inverse transformation are recorded. These tests were carried out on a one-ton machine with a rigid dynamometer, which is suited for carrying out measurements at helium temperatures. The velocity of deformation was constant and amounted to 0,03 mm/sec. A graph gives a typical diagram of the deformation in the coordinates "stress - absolute compression" for lithium. At 77°K this is the melting curve with consolidation of the shape at high degrees of deformation. There are no singular points indicating a

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transformation. If the deformation temperature drops to 20°K and less (down to 1,4°K), a characteristic discontinuity is observed on the curve with a sharp decrease of resistivity against deformation. The most direct proof of the polymorphous transformation in the tests discussed are the variations of volume in inverse transition while the deformed sample is being heated. Similar curves were obtained also for sodium. In the case of cesium no polymorphous transformation is observed on the deformation diagram even at 1,4°K. Nevertheless, the shape of the curve of heating allows us to conclude that, to a small extent, such a transformation actually exists. This behavior of the three alkali metals is apparently connected with the reduction of characteristic temperature and leads to the conclusion that polymorphism exists in the entire group of alkali metals. The discontinuity of stress in the compression diagram is observed also in the case of beryllium at temperatures of 4,2°K and less. All this seems to indicate an extensive occurrence of low-temperature polymorphism, which is observed in the case of tin, sodium, lithium, cesium, bismuth, and beryllium. There are 2 figures and 6 references, 4 of which are Soviet.

The Low-Temperature Polymorphism of Metals SOV/56-35-3-46/61

ASSOCIATION: Fiziko-teknicheskiy institut Akademii nauk Ukrainskoy SSR (Physico-Technical Institute of the Academy of Sciences, Ukrainskaya SSR)

SUBMITTED: June 7, 1958

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STARODUBOV, YA. D.

24(6) PHASE I BOOK EXPLOITATION SOV/2385

Akademiya nauk SSSR

Nekotoryye problemy prochnosti tverdogo tela; sbornik statey (Some Problems in the Strength of Solids; Collection of Articles) Moscow, Izd-vo AN SSSR, 1959. 386 p. Errata slip inserted. 2,000 copies printed.

Ed. of Publishing House: V. I. Aver'yanov; Tech. Ed.: R. S. Pevzner; Editorial Board: A.F. Ioffe, Academician; G. V. Kurdyumov, Academician; S. N. Zhurkov, Corresponding Member, USSR Academy of Sciences; B. P. Konstantinov, Corresponding Member, USSR Academy of Sciences; F. F. Vitman, Doctor of Physical and Mathematical Sciences, Professor (Resp. Ed.); L. A. Glikman, Doctor of Technical Sciences, Professor; N. A. Zlatin, Doctor of Physical and Mathematical Sciences; V. A. Stepanov, Doctor of Technical Sciences; Ya.B. Fridman, Doctor of Technical Sciences, Professor; B. S. Ioffe, Candidate of Technical Sciences (Deputy Resp. Ed.).

PURPOSE: This book is intended for construction engineers, technologists, physicists and other persons interested in the strength of materials.

COVERAGE: This collection of articles was compiled by the Otdeleniye fiziko-matematicheskikh nauk AN SSSR (Department of Physical and Mathematical Sciences) and the Fiziko-tekhnicheskiy institut AN SSSR (Institute of Applied Physics, Academy of Sciences, USSR) in commemoration of the 80th birthday of Nikolay Nikolayevich Davidenkov, Member of the Ukranian Academy of Sciences, founder and head of the Otdel prochnosti materialov (Department of the Strength of Materials) at the Institute of Applied Physics, Academy of Sciences, USSR, founder of the Fakul'tet fizicheskogo metallovedeniya (Department of Physical Metallurgy) at the Leningradskiy politekhnicheskiy institut (Leningrad Polytechnic Institute), recipient of the Stalin Prize (1943), the Order of the Red Banner of Labor (1945) and the Order of Lenin (1953). The articles deal with the strength of materials, phenomena of imperfect elasticity, temper brittleness, hydrogen embrittlement, cold brittleness, influence of deformation speed on the mechanical properties of materials, fatigue of metals, and general problems of the strength, plasticity, and mechanical properties of nonmetals. Numerous personalities are mentioned in the introductory profile of Professor Davidenkov. References are given at the end of each article.

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GINDIN, I.A.; STARODUBOV, Ya.D.

Low temperature plastic breakdown of large-grain iron. Fiz.tver. tela 1 no.12:1794-1800 D '59. (MIRA 13:5)

1. Fiziko-tekhnicheskiy institut AN USSR, Khar'kov.
(Iron--Metallography)
(Deformations (Mechanics))

GARBER, R.I.; GINDIN, I.A.; STARODUBOV, Ya.D.

Thermal hardening of twinned layers of iron crystals. Fiz.tver. tela 1 no.12:1801-1805 D '59. (MIRA 13:5)

1. Fiziko-tekhnicheskiy institut AN USSR, Khar'kov.
(Iron--Heat treatment)

24(0)
AUTHOR: Chentsov, R. SOV/53-67-4-7/7

TITLE: The Fifth All-Union Conference on the Physics of Low Temperatures (5-ye Vsesoyuznoye soveshchaniye po fizike nizkikh temperatur)

PERIODICAL: Uspekhi fizicheskikh nauk, 1959, Vol 67, Nr 4, pp 743-750 (USSR)

ABSTRACT: This Conference took place from October 27 to November 1 at Tbilisi; it was organized by the Otdeleniye fiziko-matematicheskikh nauk Akademii nauk SSSR (Department of Physico-mathematical Sciences of the Academy of Sciences, USSR), the Akademiya nauk Gruzinskoy SSR (Academy of Sciences, Gruzinskaya SSR), and the Tbilisskiy gosudarstvennyy universitet im. Stalina (Tbilisi State University imeni Stalin). The Conference was attended by about 300 specialists from Tbilisi, Moscow, Khar'kov, Kiyev, Leningrad, Sverdlovsk, and other cities as well as by a number of young Chinese scientists at present working in the USSR. About 50 lectures were delivered which were divided according to research fields.

V. Various Questions.

One of the most interesting lectures delivered at this Conference was that by I. A. Gindin, B. G. Lazarev, Ya. D. Starodubov and V. I. Khotkevich (KhPTI) on the polymorphism of metals at low temperatures; P. L. Kapitsa commented on this topic during the discussion. N. F. Sulatova, V. S. Kogan and B. G. Lazarev (KhPTI) investigated the system hydrogen-deuterium by the methods of low-temperature-radiography, thermal analysis, and the visual observation of crystallization. Kh. I. Amirkhanov, Sh. Kh. Amirkhanova and R. I. Bashirov investigated the thermomagnetic properties of compounds of the type $A^{III}B^{V}$ and $A^{II}B^{VI}$, and dealt with the phenomenon of the "photon wind" predicted by Gurevich; the investigation was carried out at the Dagestanskiy filial AN SSSR (Dagestan Branch, AS USSR). N. M. Reynov and A. P. Smirnov (LPTI - Leningrad Physico-technical Institute) gave a report on the measurement of the electricity limit of tin- and indium polycrystals at very low temperatures ($1^{\circ}K$), and N. M. Reynov and N. I. Krivko (LPTI) spoke about attempts made to find the expected diamagnetic resonance on polarons in cuprous oxide. G. R. Khutsishvili (TGU i Institut fiziki AN Gruzinskoy SSR - Tbilisi State University and Institute of Physics AS Gruzinskaya SSR) carried out a theoretical investigation of the Overhauser effect in non-metals. Lomkadze investigated the electron- and nuclear (proton) resonance in diphenylpicryl hydracyl at helium temperature. B. N. Samoylov spoke about experiments he carried out concerning the orientation of Co^{60}- and Au^{198}-nuclei (in iron) at extremely low temperatures. B. P. Zakharchenya and Ye. F. Gross (LPTI) investigated the absorption spectrum of a cuprous oxide crystal in the magnetic field at helium temperature and observed the effect of magneto-optical oscillations. V. P. Peshkov and M. P. Malkov gave information concerning scientific work of Soviet scientists in foreign countries (zagranichnaya nauchnaya komandirovka), and E. V. Shpol'skiy spoke about the abstracting journal "Fizika". The head of the department for problems of the physics of low temperatures, Academician P. L. Kapitsa and the President of the Academy of Sciences Gruzinskaya SSR, Academician N. I. Muskhelishvili closed the Conference. The 6. All-Union Conference on the Physics of Low Temperatures will be held in June and July 1959 in the city of Sverdlovsk.

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AUTHORS: Gindin, I. A., Starodubov, Ya. D.

TITLE: Slippage Along the Boundaries of Twins During Direct and Reciprocal Twinning of Iron

PERIODICAL: Fizika tverdogo tela, 1960, Vol. 2, No. 6, pp. 1070 - 1081

TEXT: The present paper describes some peculiarities of deformation occurring in direct and reciprocal twinning of iron on the boundaries of these twins. It was the aim of the authors to find the cause of the different behavior of the interfaces under static load. Preceding papers (Refs. 1 and 2) have shown that the twin layer became thicker, and that one interface of the twin layer remained immobile, while the other was shifted. For their study the authors used iron (degree of purity: 99.99%, grain diameter: 2 - 2.5 mm) which was annealed for five hours at 800° after polishing the boundary faces. A multistage deformation at the temperatures of liquid nitrogen was carried out on the samples with room-temperature heating in between. It was thus possilbe to observe the appearance and disappearance of the twin

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double layer, as well as its boundary shift with increasing load. The deformation to be reached per deformation step was chosen from 0.1-0.5%. Changes were observed by the microinterferometric method with a microscope of the type МИИ-4 (MII-4) and by variations arising in the etched lines. Experiments established that the lines suffer a break on compression and are displaced on a boundary plane. This displacement was likewise observed on the break of the interference stripes on one boundary. The displacement, however, did not increase with further increasing load. If the displacement was missing in the initial deformation stage (it could not be observed on all identical boundary layers of a twin system), it did no more arise on any further intensification of the deformation. It is concluded therefore that the slippage along the plane (112) must take place before the twin formation, i. e. while the lattice changes over to the twin formation. An "accomodation region" often forms besides the displacement on the slip plane. Still, one phenomenon does not necessarily entail the other. Slippage occurs in the direction [111], which coincides with the direction of displacement in the twin formation. The twin layers again disappear with load having an inverse sign (so-called mutual twin formation). The critical stress for the reciprocal twin formation is somewhat higher than that of

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the direct twin formation. A table offers data on the twin formation for direct and reciprocal twins. Various explanations for the formation and removal of twins are discussed. The authors finally thank R. I. Garber and B. G. Lazarev for their discussions. There are 9 figures, 1 table, and 7 references: 5 Soviet, 1 German, 1 British

ASSOCIATION: Fiziko-tekhnicheskiy institut AN USSR Khar'kov (Physicotechnical Institute of the AS UkrSSR, Khar'kov)

SUBMITTED: June 24, 1959

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B122/B063

18.8200

AUTHORS: Garber, R. I., Gindin, I. A., Lazarev, B. G., Starodubov, Ya.D.

TITLE: Low-temperature Recrystallization of Copper

PERIODICAL: Fizika tverdogo tela, 1960, Vol. 2, No. 6, pp. 1096 - 1098

TEXT: The authors of the present article studied the recrystallization of copper which was first deformed at the temperatures of liquid hydrogen and nitrogen, and was then subjected to recrystallization at room temperature. Tubular copper samples (diameter: 1.5 mm; wall thickness: 0.45 mm) were used. The samples were first annealed at 800°C for 8 hours (at 10^{-6} torr). Special care was devoted to the perfect cleanliness of the inner wall of the tube. The sample was deformed in vacuo at 20 and 4.2°K perpendicular to the tube axis until the inner walls touched, and further, until the plastic deformation δ = 23 %. The sample was then heated at low pressure, and kept at room temperature for 10 - 15 hours. Recrystallization was observed on a cut of the cross section of the tubes after deep etching, by using a metallographical microscope of the type МИМ-6 (MIM-6) (Figs. 1 and 2). Small

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bridges of recrystallization grains were observed along the contact planes. With dropping deformation temperature the number of outgrowing grains increased. The experiments showed that copper deformed at low temperatures is well recrystallizable already at room temperature, and that the idea of temperature threshold of recrystallization is a preliminary one, i.e., when constructing the recrystallization diagram it is necessary to consider the temperature at which the plastic deformation is activated. There are 2 figures and 6 Soviet references.

ASSOCIATION: Fiziko-tekhnicheskiy institut AN USSR, Khar'kov (Physico-technical Institute of the AS UkrSSR, Khar'kov)

SUBMITTED: August 11, 1959

GINDIN, I.A.; LAZAREV, B.G.; STARODUBOV, Ya.D.

Characteristics of the mechanical properties of lithium connected with low-temperature polymorphic transitions. Fiz. met. i metalloved. 10 no.3:472-480 S '60. (MIRA 13:10)

1. Fiziko-tekhnicheskiy institut AN USSR.
(Lithium--Testing) (Metals at low temperatures)

20799

S/181/61/003/003/025/030
B102/B205

24.7500 1143, 1160, 2807, 1418

AUTHORS: Gindin, I. A., Lazarev, B. G., and Starodubov, Ya. D.

TITLE: Discontinuous character of plastic deformation at low temperatures

PERIODICAL: Fizika tverdogo tela, v. 3, no. 3, 1961, 920-925

TEXT: The discontinuous character of plastic deformation of crystalline bodies has been known long (A. F. Ioffe, Ehrenfest, M. V. Klassen-Neklyudova), and the various effects of discontinuous deformation have been investigated many times. In the authors' view, however, this problem has not yet been studied in detail, which is the purpose of the present work. Elongation and compression diagrams of the following metals were recorded by a machine equipped with a sensitive, rigid dynamometer between 1.4 and 77°K and at a deformation rate of 30 μ/sec: aluminum, beryllium, bismuth, tungsten, iron, cadmium, potassium, lithium, magnesium, molybdenum, copper, sodium, nickel, tin, lead, antimony, silver, mercury, tantalum, titanium, chromium, cesium, zinc, zirconium, and uranium. In this connection, it was necessary to classify the deformation jumps and to make a detailed study of

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a new kind of faults which are important at 4.2°K and below this temperature. The principal results of these investigations are published here. The discontinuity of the low-temperature deformation is essentially caused by: 1) mechanical twinning, 2) polymorphous transitions, 3) peculiarities of the plastic deformation of high-purity metals (mechanical recrystallization, sliding along the grain faces, twinning), 4) relaxation processes with a regular increase of jumps. These four cases were investigated individually. Figs. 1, 2, and 3 show the diagrams of deformations on mechanical twinning (1), polymorphous transition (2), and of relaxative jumps (3). These diagrams were recorded by the computer machine. Ad 1: The authors studied the extension elongation of coarse-grained iron of 99.99% purity at 77°K. The jumps are only caused by twinning processes. The kind of the effect depends largely on the grain size. Fine-grained material showed no twinning jumps. Jumps of this kind can thus be prevented by an adequate thermomechanical treatment of the material. Ad 2: Jumps due to polymorphous transitions occur in the compression of Li or Na. Fig. 2 shows diagrams obtained for Li (purity of 99.93%) at 20 (1), 4.2 (2), and 1.4°K (3). The transition into the stable low-temperature modification takes place after a certain degree of deformation has been

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reached, and is accompanied by the occurrence of considerable faults. These jumps occur only if the deformation takes place below the temperature of the polymorphous transition. Ad 3: High-purity metals, such as Al (99.994%) and Fe (99.99%) show mechanical recrystallization within the range of helium temperatures, i.e., grains are formed, which are larger than the initial ones. The process is somehow similar to mechanical twinning. Ad 4: Whereas the effects described above occur only under certain conditions, all the metals investigated show deformation jumps at sufficiently low temperatures and a corresponding stress strain, which are due to relaxation processes. These are characterized by a certain rule (Fig. 3 shows it for Fe (99.99% pure) at 4.2°K). They are due to the fact that elastic energy accumulates and is released at a certain value. For some of the metals examined here, a table contains the temperature and the degree of deformation at which the elongation process takes place discontinuously and regularly. In some metals, an increased elevated strain stress corresponds to an elevated temperature (e.g., in the case of Na), but there is still a temperature threshold above which no such jumps will appear any longer, not even at maximum stress; (for Na, e.g., above 20°K). The rules governing the jumps are observable both during compression and elongation. There are 7 figures,

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